

Homemade Electric Kiln



by Wolfgar77

I was frustrated with the price of electric burnout kilns for ceramics, metal annealing, glass enameling, and melting precious metals etc., so I decided to build my own. Most kilns that run at these temperatures cost between \$600 and \$1200. With a little help from a guy at a ceramics store, I built one for about \$120 (not including the power controller and pyrometer). This little electric kiln can get up to 2000 degrees F and is easy to make without any special tools besides a handheld router. I also wanted one that I could take apart and replace the element, since these are inexpensive.

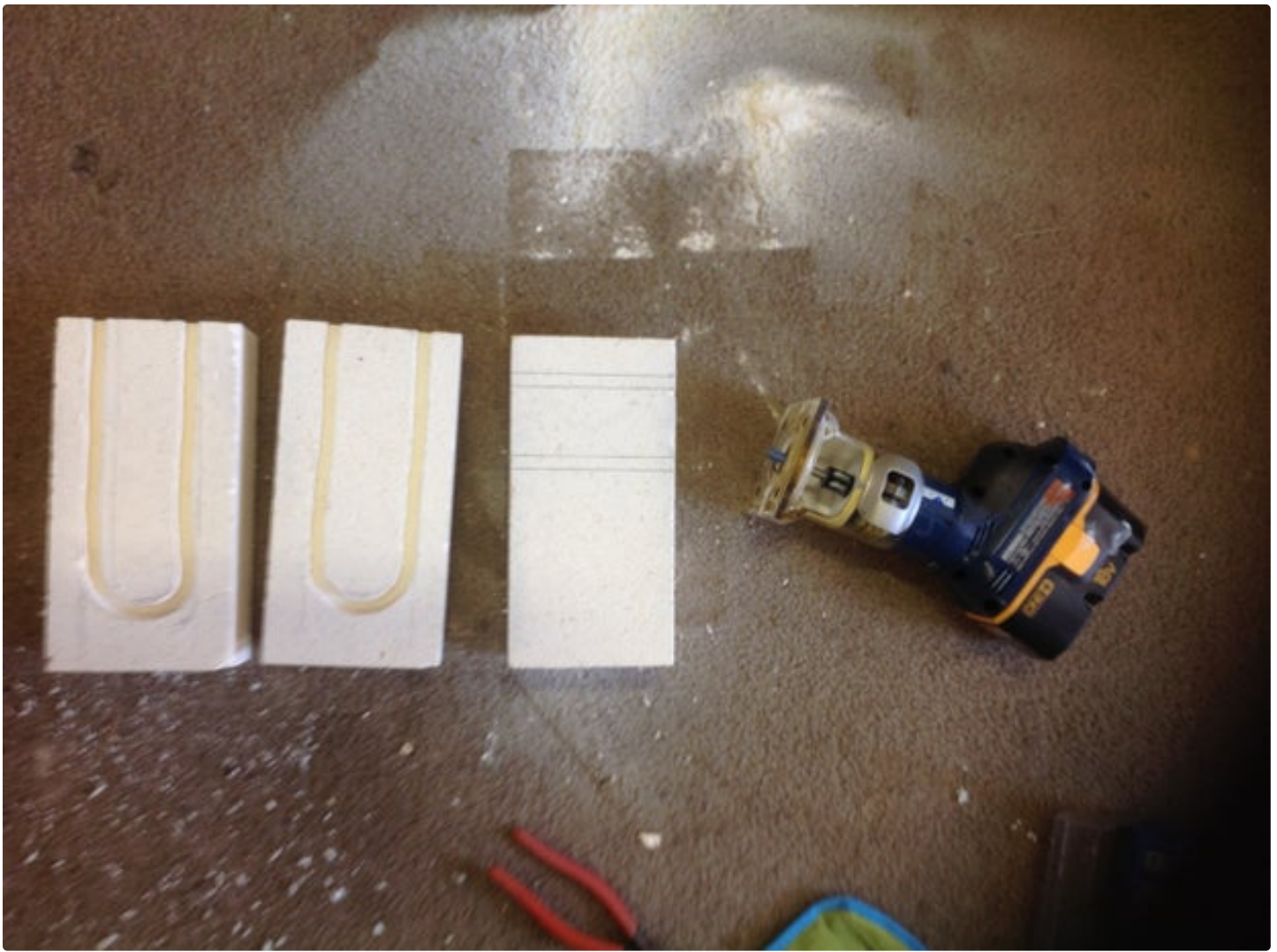
Materials:

1. 8 x 10" bolts with nuts- 1/4" diameter
2. 7 x soft insulating fire bricks (4 1/2" x 9" x 2 1/2"- make sure they are soft)
3. About 7 feet of angle iron from Home Depot (this is the frame) (4 x 14" legs/corners, 2 x 9" floor supports)
4. One sheet of thin aluminum (for the door). At least a 9" by 9" square
5. One 3/8 inch x 18" coiled heating element (stretched to about 28") out of 16 gauge Kanthal wire. I had this wound for me at the local ceramics store. I recommend you wind your own or as a ceramic supplier in your area to wind one for you. In my other instructable, Electric Kiln -Top Loader, I give directions on how to wind your own.
6. One small hinge with screws
7. Fire proof pins (should come with element) or you can make these out of the Kanthal wire.
8. Short outdoor extension cord rated to at least 10 amps (cut down to about 6 feet)
9. Stand alone ICS kiln controller. Sundanceglass.com has one for \$84.
10. 1" thick Kaowool- about 1 foot square

Tools:

1. Hand held router with 3/8 inch bit
2. Wrench
3. Needlenose pliers
4. Hacksaw
5. Wire cutters/stripper
6. Drill
7. Tin snips





Step 1: Cutting the Channels

1. Pencil the channels in as a u-shape $\frac{3}{8}$ inch wide. I left about an inch, to an inch and a half from the edge and the top of the "U" so the elements are not too close to the opening of the kiln.
2. Route out the channels with your router using a $\frac{3}{8}$ inch bit.
3. You will need to cut one of your fire bricks down to a square $4\frac{1}{2}$ " by $4\frac{1}{2}$ " for the back and route out two straight channels. This will be the back wall.



Step 2: Putting in the Element

1. You'll need two bricks for the floor, as pictured.
2. The dimensions of the fire bricks are $4\frac{1}{2}" \times 9" \times 2\frac{1}{2}"$ - when you construct the firebrick box, the kiln will be too wide across (2 outside walls at $2\frac{1}{2}"$ and your back wall is $4\frac{1}{2}"$, for a total of $9\frac{1}{2}"$). To make the walls flush with the roof and floor ($9"$) you will need to take out a $\frac{1}{2}"$. In the first pic you can see I shaved off a $\frac{1}{2}"$ from the right side. Any saw can cut these bricks, they are very soft.
3. The element I started with was 18" inches long. Separate the coils of the element so that they aren't touching. If you are unsure of how to do this, then you can always ask the people at the ceramic store. This stretched my element out to 28 inches not including the pigtails. My element cost me about \$25. If you make your own don't forget to make 5 or 6 inch pigtails to stick through the back holes for your power hookup!
4. You'll need to drill two holes out the back of the kiln so you can run the ends of the element out the back. These are drilled inside the top channel about 1" apart. Pick a drill bit slightly bigger than your element wire.
5. Thread the element into the channels as shown.
6. If the ceramics store gives you pins, I found it was better to use pliers and make little u-shaped pins out of them. You can push these into the fire brick about an inch apart to keep the elements in the channels. It doesn't seem important now, but when you start firing, the element will want to flex and move around. The pins will keep it fixed in the channels.

****update** - There have been many questions about the element I used and where I purchased it. I had hoped people would ask questions from their local ceramics store and get answers there. That is where I had my element wound for me. I have learned a few things since then. The element is a type of NiCr wire called Kanthal. Most Kanthal is rated to about 2450 F. There are other element types if you need higher temperatures. Kanthal is used in low-fire/ceramic applications. Either find a ceramic supplier to help (as I did) or you can contact a place like Joppaglass.com and have an element made to your specifications. They will usually want to know the voltage of the power source, max amperage (my garage is 10 amp breaker) and the gauge of wire (I think mine is 16 gauge). The arbor (inside and outside diameter of the element) can be requested and you can get the element you want. I have started to wind my own and you can find those instructions in my instructable about my top loader kiln.







Step 3: Making the Frame.

1. The frame I designed, squeezes it all together. Cut four 14" lengths of the angle iron with your hacksaw for the corners.
2. Cut two 9" lengths for the bottom. These two pieces hold the floor and rest on two 10" bolts on the bottom.
3. Thread the bolts as shown--4 on top, 4 on the bottom. Two of the bottom bolts hold up the floor, the rest just squeeze the whole project together to hold the bricks in place.
4. Remember to place two bricks on top for your roof. Also, you can see that I have the whole project off the floor by about 3 inches.

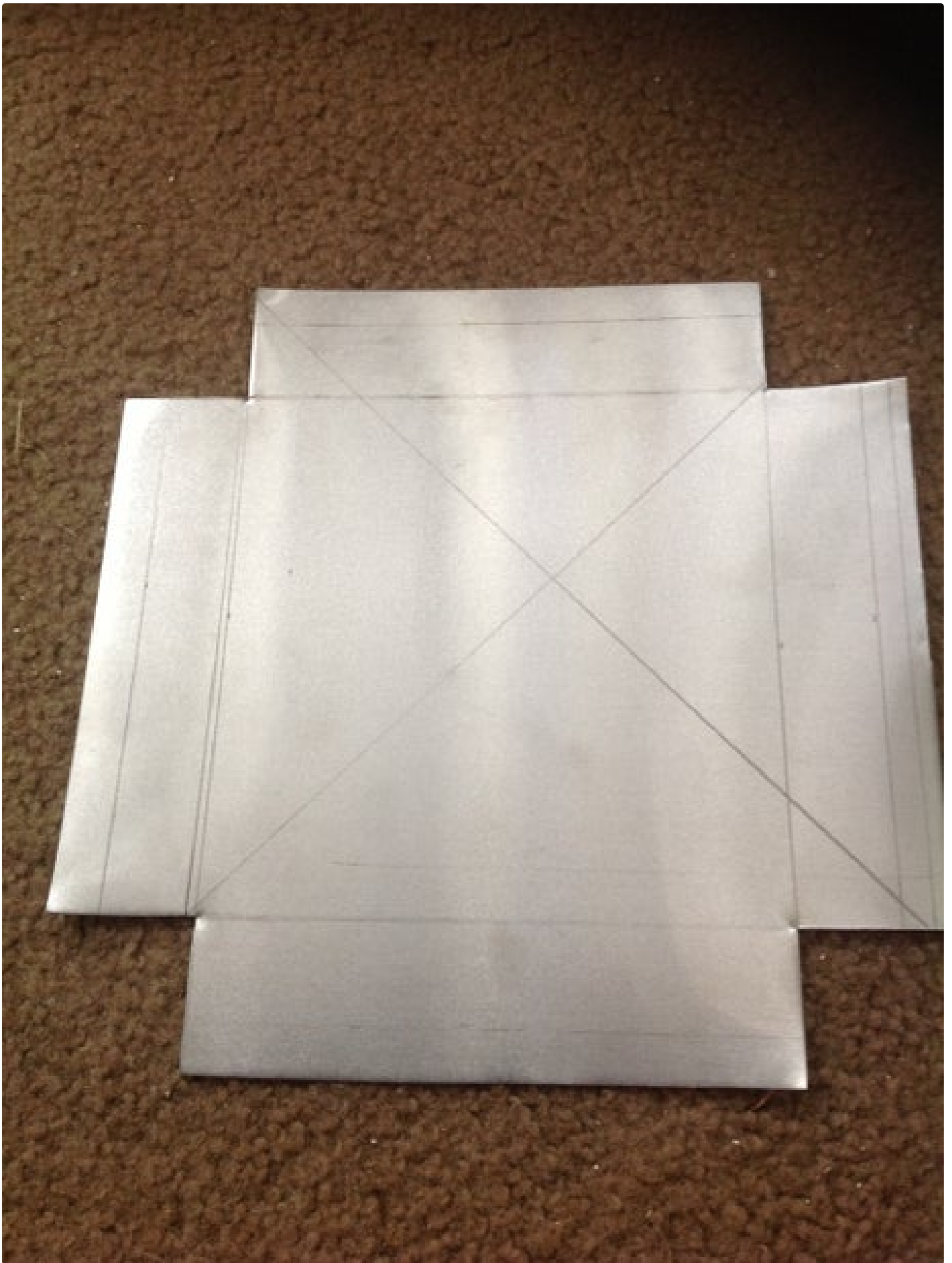
*Safety tip--never use this or any other kiln on a surface that isn't fireproof. I always have this on my concrete floor in the garage.





Step 4: Making the Door

1. With your tin snips, cut your aluminum sheet into the shape shown in the picture. You can use steel plate if you want. I believe mine was 22 or 24 gauge. It won't get too hot to melt because you will insert insulating Kaowool inside! The dimensions I used make a 6 inch door. The central square is 6" and the tabs are 1 1/2". (So start with square 9" by 9" and cut out the corners)
2. I used a sophisticated metal break to bend the metal (called my fingers and a scrap of wood). Bend the tabs up so you have 1/2" on the inside and the door itself is 1" thick.
3. Cut a 6" x 6" square of the 1" thick Kaowool and squeeze inside the metal as shown.
4. Attach the door with a small hinge. I pre-drilled some holes in the frame and used metal screws to screw it to the frame. I didn't put a latch on this. As an option you could by-pass this step and use another fire brick over the entrance.









Step 5: Connecting the Power

1. Cut an outdoor electrical cord(10 amp) down to 6 feet and keep the plug end. You don't want it too long.
2. Strip the wires and connect to the element wires coming out the back of the kiln. My element came with metal connectors and ceramic sleeves. The sleeves are optional. I have since used small bolts to attach the power. This separates the terminal wires from the copper wires of your power cord and the nuts and bolts act as a heat sink to keep your wires from getting too hot
3. You need to ground this by attaching the green wire to the frame. I just found a small metal screw and attached it to the frame.
- 4.

****update 1/5/2017:** A lot of people have asked me about my green controller. This was from an old Nova kiln and has no numbers or markings on it. I have done some research on the type of controller you will want. They are called stand alone ICS kiln controllers. I have found one at Sundanceglass.com (pic 2 and 3) and have ordered one for myself as a backup for my controller. This is an infinity switch which will turn the power off and on depending on the setting you use and will allow you to obtain an even temperature. Use a thermocouple and pyrometer to monitor your heat and then you will know what setting works for the temperature you are trying to reach. There are some people in the comments that have used PID controllers and they have Instructables on how to wire them up to your kiln. I think cost wise, it is about the same to order an ICS controller or a PID controller.

****Safety tip--Do Not plug this directly to a wall outlet. Also, do not touch the element wires when the kiln is on.**

5. I ran a piece of flat iron across the back wall of the kiln so that the back wall has more stability. This is not essential. When I first made my kiln, the squeeze of the frame held the back wall in fine.







Step 6: Finished Kiln!

1. In the original incarnation of my kiln (1st pic) I drilled a hole in the top and mounted an old thermocouple/pyrometer on top of the kiln.
2. I have recently upgraded to a better thermocouple (Pic 2) and directly connected this to the analog temp. gauge on my controller. I was lucky and had one of these from an old kiln I broke. For accurate firing temperatures I recommend a K

Type thermocouple with a digital pyrometer. Another option for ceramics or glass enameling would be to drill a viewing hole in the side and then buy a ceramic plug for it.

3. I have run this for many hours at various temperatures (3rd pic). I really have not experienced any problems except my element still wants to pop out of those channels. I'll just have to keep an eye on them.

Please let me know what you think or questions you have.

**update Dec. 11 2014- I have run this kiln now for hundreds of hours (firing clay, PMC clay etc.) and found the max temperature to be 2300 F.









Thank you for this Instructable - it was one of the key documentations I needed for making my own so that I could make my fiance's engagement ring (<https://www.instructables.com/id/Casting-Rings-From-Startup-to-Finish/>).



that is awesome! You are the first to post one! Do you have an instructable for your ring? That is a cool setting- did you make it out of Pmc clay?



Yes, I detailed the ring making, kiln build, vacuum chamber construction, and the necessary step-by-step guide to all (see the link above). I actually ended up 3D printing the initial ring using a polyjet printer available at school and then converting it into wax using a rubber mold (the 3D printed parts didn't burn-out the best) before casting.

I would have had a much harder time with everything without your instructable!



sorry, I didn't see the link:) - I love the PID controller! That is a nice upgrade-I'll have to add one to mine. I make jewelry also but I'm old school. I want to learn the lost wax casting so I'll be visiting your instructable often in the future. Congrats on your engagement!



This is a great idea; but you have to do your sums, I was looking for a place to cast some gold, on a one off basis. Couldn't find anywhere so next choice was looking for second hand equipment with the idea that I could sell it on afterwards but there is very little available in the UK. So next idea was ok I'll make my own, what do I need, a kiln that will let me both burnout wax and melt gold. Perfect your kiln will do both. But if im not using a centrifugal casting system then I need a vacuum table for both the investment and pouring the metal that's ok I can build both.

Then I discovered casting houses! Yes their gold price is higher than Cookson or Rio grande but the overall extra cost is a fraction of the cost of building your kiln let alone the vacuum table!

So as much as I would like to cast the two items ill get a much better quality job done for less money with a casting house.

Dan



We're on Hackaday!

<http://hackaday.com/2014/12/10/casting-engagement-rings-or-other-small-metal-parts/>



That is amazing. I used this kiln to make my fiance's engagement ring too but I didn't document it like you did. I will definitely be using your walk-through to improve my process for when I start making the wedding bands! Thanks!



This is great!! Simple and functional. And very well explained, I have no doubt I can make this with your instructions. Thank you so much, I would never be able to afford one otherwise.



awesome. i want to make so I can blow glass. wondering how I could do it and bam -your instructable. thanks.



Terrific!! I have been trying to find an inexpensive kiln for copper enameling for years. Never could afford a store-bought one. Thanks. This appears to be fairly easy to build.

Robert Larkins



An excellent project and so simple!
I'll be assembling one of these soon for smelting Tin (Sn) ore.



Thanks!



Thanks! I have been wanting to make -- not a high temp kiln, but a low temp oven for polymer clays, and this instructible gave me insight on how to construct it.



Thank you so much for showing how to make a kiln! I have been wanting one forever but where I live they usually run \$1500 and up -- way out of my budget. Now I will be able to build my own at a much more affordable price. Thanks!



You are more than welcome. I was in the same boat! Necessity is the mother of invention.



Awesome Ible!!!

Expensive store bought kilns have the same problem with the elements popping out - they heat up, expand, and voila, out they pop! (so don't take it personally!)

My paragon kilns have metal staples that hold the elements into the channels - they often come loose and need to be pushed back in, I believe they're just steel - would that work?

Also, for around your door - perhaps a woodstove gasket would work? I've used it instead of foil as a gasket, works great, cheap as hell.

Either way, nice job. Looks a helluva lot nicer than my waffle iron kiln!



Thanks- your waffle iron kiln is a great idea and one of the first ones I looked at before building this. I almost built your waffle iron kiln but for some of my projects I was afraid it might be too small. Thanks for some of my original inspiration!



Great job putting this idea together!

Cutting the soft blocks is easy with an old, or new, hacksaw blade. I used the end of the bolts to groove my blocks by slowly dragging the end with threads along the lines. The rounded groove is perfect for the element. There is a lot of silica (and alumina) in the blocks, and a router is overkill (IMHO), with dangerously hazardous dust. Silicosis results in permanent lung damage and is a progressive, debilitating, and sometimes fatal disease of which there is no cure (except a lung transplant).

Idea: I carefully collected the silica dust (+- 1/2 cup). Not sure what I will do with it, but it could be added to tumbler slurry for polishing; used as a fill/thickener for resin; grog/mortar additive... hmmm



Yeah, I do the routing outside and with a dust mask on...



You probably are not in danger of silicosis unless you build these every day for a couple of years though!



Jopglass has posted a comment..

http://joppaglass.com/small_el_kiln_proj/Instruct_kiln_proj.html



This is an awesome design and very useful for doing solid state chemistry which often requires running around 2200-2300F, but anyone making it should heed Joppaglass' advice. Partly to make it work better, and partly to make it much safer.

First, pinning the elements is important especially if you are going to run at the top of the temperature range as they will tend to sag out. A PID controller with an alarm is a good idea too, though the kanthal A1 (or Nikrome 80) will melt before the thing heats up to dangerous degree even if running full on out of control provided the kiln is kept well away from anything flammable.

But the most important bits of advice are electrical safety upgrade suggestions (see http://joppaglass.com/small_el_kiln_proj/Electrica... They are a huge improvement and should be followed by anyone making this.

Basically, use at least 14 gauge wire (or salvage from a 15amp rated power cord not 10amp which uses 18g wire). Don't run 14amps through a 10amp rated cord. The author gets away with it because the cord is short and the kiln doesn't draw 14amps continuously. For extra safety, use 12gauge wire.

And he has a super diagram of how to make the connections safe. He's right. The back of this (and I should add every other kiln/furnace design I have seen) is kind of a death trap. I used his design to improve my similarly designed metal melting furnace with equally exposed wires and I'm glad I did every time use it. I don't have to worry about touching live exposed wires and accidentally electrocuting myself. Nor do I have to worry that the method of connecting source wires to heating wires and tucking them safely out of the way for electrical safety creates a fire hazard. It added very little cost to bring it up to commercial kiln safety standards.

One easy extra safety tip: Use a 3 wire cord with a ground and wire the ground to the frame. That way if a live wire touches the frame, it will not shock you even if you touch the frame.

Combine this design with the suggested safety upgrades and a PID controller controlling a solid state relay, along with a K type thermocouple for the PID and you have something a lot like a tabletop furnace Rapidfire Pro-L or Pro-LP (depending on what PID controller you use) for a fraction of the \$650 they now run.



Thanks for some of ideas, this was merely a prototype and do have a ground on mine...I'm pretty sure the instructable has that in it...I'll double check. Housing the back in a electrical box is also a good idea.



Hi! I'm building a very small oven for burnout process. What I am so confused of, when I did the math to determine how much Kanthal wire do I need for my tiny kiln, I am amazed that I need around 28ft of Kanthal Wire! I tried coiling it using my 10mm tube, but there's so much wire I can't figure out how do I add more channels to the bricks just to accommodate the additional length. Hey! I decided to take a plunge and tried it anyway. Oh boy, It was such a bad idea! Hahaha! the coils started sagging, shorting each other and eventually melted most of the wires.

So I decided to check Commercial Tabletop burnout kilns (yap, those things sold at \$1k or so), and it was amazing how there's less Kanthal Wire in there! I asked around and confirmed they are using the same Kanthal Wires. So how that happened?

For about a week I was sitting at my desk looking at all of the calculations needed and one day it hits me! I'm not going through the details, but bottomline is the lower the voltage, equal less power, and in turn less wire needed. Now here's the question:

Has anyone tried using Variac on kilns and go lower than 110V? if yes, what's the trade off? slower ramp time? any potential issues? Sorry i'm so new to building kilns so forgive me for my ignorance.



I don't think you need a variac, although I saw some with those that controlled the power. I do list the controller I use now in my instructable. You definitely need a controller and shouldn't plug this directly to a wall outlet.



anyone have an Amazon link for an ics controller? the sundanceglass company is closed for now



Not an amazon link... but you can get one here or on paragon's website.

<https://www.theceramicshop.com/product/11741/pcb1-controller/>



This gives me hope! One question, if i would like to have more loading volume (like 160l) or create this as a toplayer what would i have to change without losing the marvellous 2300F?



I have an instructable for my little toplader if you want to see that design. It gets more complicated with bigger kilns. Higher watt requirements, longer coils, etc. If you increase the size, your element will be longer and draw more power, plus take longer to heat up. Just some things to think about.



Thank you so much! I will try to build the toplader then. I also have the problem that I can't create anything that uses over 2.5kw-3kW because this will cause a rash action. Do you know how much the toplader consumes? Thank you in advance!



I think the top loader uses about the same as this one... you'll have to calculate it though. I don't have an exact number.



Thanks for sharing this. I'm thinking about modifying my store bought kiln to increase its depth with additional fire clay bricks and heating elements. According to the specs of my store bought kiln the max. temp. is 2350F, So this home made model looks effective in regards to temp. My kiln has a insulation brick thickness of 2.5 inches for the roof and walls of the kiln. The heating element coils are spaced 2 inches apart, starting 2 inches from the floor and ending 2 inches from the ceiling and reaches the max. temp. of 2350F in 2hrs 47min. Since the coils are recessed into the bricks walls, there's 1.5 inches of brick insulation thickness left in these recessed regions. The rotary switch is rated at 120v 15 amps. I think this switch is over rated and the 2 heating elements provide resistance down to around 11 amp of current. The taps off this dial switch are a power in COM and + with a light daisy chained into these taps to indicate on or off and an L1 and L2 tap to provide power to 2 heating elements. Considering the 2 heating elements other 2 legs are wired in series, I assume the 2 legs off of the Dial switch leading to the 2 heating elements are a + and -; and assume the current runs into the top coils right leg, out of the top coils left leg into the bottom coils left leg and back out of its right leg to the switch. My plan is to find an appropriate manual dial switch to run an additional set of 2 heating elements in the original manner and then double the walls height capacity from 4.5 to 9 inches. to modify the kiln. Basically just copying everything that's going on onto the lids lip, running the kilns 2 dials in mirror settings, and unbolting the lid and rebolting onto the new "top". The model is an older paragon firefly manual model (vs digital). Perhaps Some of these stats would help others in kiln design for DIY projects.



How would you change this to make it deeper, just a longer wire? And more brick?

Awesome design btw, thanks



Yes, I would measure the extra distance and just add another brick. Keep in mind that with 120V, your longer coil will take longer to heat up and reach the temp you want...but it should work.



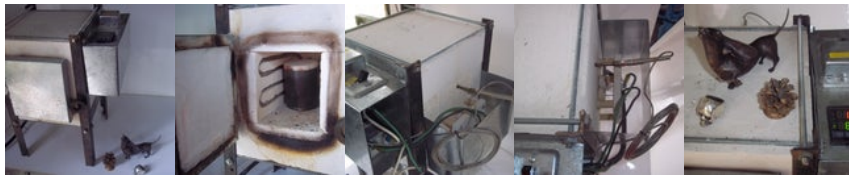
Hello I am interested in making this kind of Oven for my burn out during casting and metal smithing. However I will want it to be a gas fire kiln. Please what adjustments can I make to produce a gas fired kiln instead. Thank you.



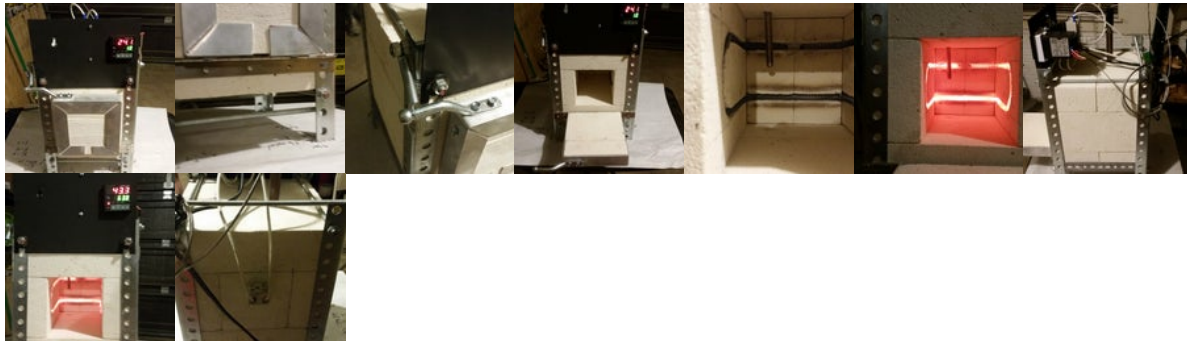
Sorry, I can't advise you on that build....



I made a near exact duplicate and use it frequently since it works so well. Except I went too cheap and bought a controller without a "ramp" mode so I have to manually raise/lower the temp. And for the door I just used a magnet to the frame. The cutdown firebrick as a "cork"-type door fell out at high temp so I made that sheetmetal door filled with kaowool. And Dudley at joppaglass helped me make it safer than I would have. that soft firebrick routs with a Dremel like a dream, but it's messy! (can you tell I'm proud of my creations?!) That dachshund should have been 3 pieces but turned out to be 4. My coworker (33 yo) did not even know what the word kiln meant- Thanks Calif. schools! And honestly, Thanks Wolfgar77!! everything you said I agreed with. Sincerely, andy k



I just made a few changes to this build. I used some leftover brick for the door on mine, hooked up a PID to it and I used a ceramic block to connect the element to the power in the back.



hello, make a furnace for me, or if you can send me the whole diagram, electrical connections, etc

Love the door! Great job!

There are many considerations to take into account before you buy a kiln. Buying a kiln is a major expenditure; take the steps to ensure that you will be happy with your purchase for years to come. If you are an active potter, you may even decide you need more than one kiln. There are lots of benefits to having a kiln, and lots of times, you just need to make sure you know how to use it. One of the best kilns that you can get is the Rapidfire Pro Electric Kiln with Digital controller. visit below link for more details.

<https://spinningpots.com/the-best-pottery-tools-an...>

I think you are missing the point of what Instructables is. This is a site of people that like to make things and not buy them off the shelf. The point of this Instructable is that kilns, like the one in your post, cost \$500-\$1000. You can build one yourself for fraction of that cost!

Fantastic! I acquired an old home-made kiln without a controller and was completely befuddled on how to handle the electrical part. Your guide and ideas and links for the paragon controller and pyrometer served me well and the guide on how to wire was priceless. I know I sound amazed but you saved me \$500. for a new kiln. I was afraid to fix this old one until I read your guide. Thank You!

I'm glad it helped!!!!)

You out to sell these! I would buy one!

Thanks! Maybe I will.

wolf; exciting challenge for me to get my kiln finished, but.....

just wondering about the Kanthal coil. I must assume the coils overall length on my mandrel is 19 inches (not including the pigtails) correct? Also, as stated, the coil should be 3/8 inch, meaning the o.d. of the coil is 3/8"?

Thanks for your inspiring creativity!

yes, to all of your questions. Just don't stretch it out too much when separating your coils or it will be too long. My outside diameter was a little bigger when I ended up making my own coil because my mandrel was 1/4" and the width of the wire pushed it up slightly over 3/8". I just filed

my channels down a little and it fit fine. I think the last element I made was about 18 inches. You don't want to go much shorter than that or the kiln will heat up too fast with too little resistance. Please let me know if this helps and how your final kiln turns out!



Hello sir, I was wondering how much watts this furnace uses.

I am making a furnace myself and I can only use 1500-2000 watts due to my outlets having a max of 16A AND the group being connected to the living room and fridge.

So there are little amps left for me.

My furnace (Foundry) is 0.15 cubic feet, do you think this is enough to heat it up to Alluminium melting temperatures?



Probably not. I'm not an electrician, but I have mine in the garage and I can barely run anything else on that circuit without tripping the breaker. On dedicated circuit you will have enough heat to melt aluminum though.